

# TPS65980EVM

## User's Guide



Literature Number: SLVUA50  
April 2014

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# TPS65980EVM

## 1 Introductions

The Texas Instruments TPS65980EVM evaluation module (EVM) helps designers evaluate the operation and performance of the TPS65980: a DC/DC switching regulator that receives power from a Thunderbolt bus ranging from 2.5V to 15.75V on TBT\_IN and generates three separate 3.3V supply outputs TBT\_OUT, CBL\_OUT, and DEV\_OUT.

The TBT\_OUT supply provides power to the local peripheral Thunderbolt™ controller and support circuitry. The CBL\_OUT supply provides power back to the Thunderbolt™ cable and has adjustable current limit. The DEV\_OUT supply provides power to all other circuitry in the device to perform its designed function.

The TPS65980 is available in a 24-pin 5mm x 4mm x 0.9mm QFN package.

**Table 1. Device and Package Configurations**

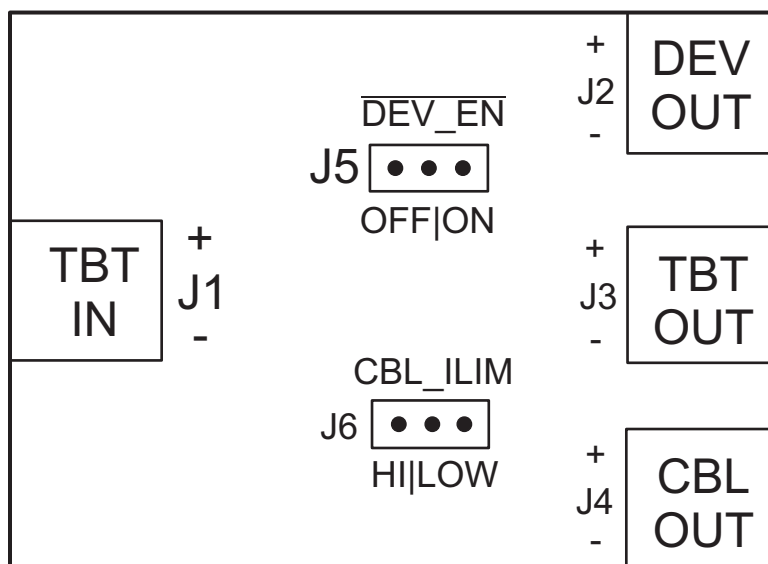
| CONVERTER | IC          | PACKAGE |
|-----------|-------------|---------|
| U1        | TPS65980RHF | RHF     |

## 2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS65980EVM.

### 2.1 Power Supply Inputs

[Figure 1](#) shows the connection points needed to fully and correctly interface with the TPS65980EVM.



**Figure 1. Connection Points**

The TPS65980 has three operating modes dictated by the voltage applied on TBT\_IN. The total power available at each of the outputs is determined by the operating mode. Table 2 summarizes the operating modes in terms of input voltage range and output current ranges.

**Input/Output Supply Ranges**

| Operating Mode       | TBT_IN Vrange | TBT_OUT Irange <sup>(1)</sup> | CBL_OUT Irange <sup>(1)</sup> | DEV_OUT Irange <sup>(1)</sup> |
|----------------------|---------------|-------------------------------|-------------------------------|-------------------------------|
| Low Voltage          | 2.5V – 3.4V   | 5mA – 50mA                    | Output Disabled               | Output Disabled               |
| High Voltage         | 10V – 15.75V  | 235mA – 1A                    | 0 – 1.44A <sup>(1)</sup>      | 0 – 2.5A                      |
| High Voltage (Sleep) | 5.2V – 15.75V | 5mA – 31mA                    | 0 – 235mA                     | 0 – 700mA                     |

<sup>(1)</sup> Note: the total combined output current from TBT\_OUT, CBL\_OUT, and DEV\_OUT should never exceed 3.5A.

## 2.2 Jumper Settings

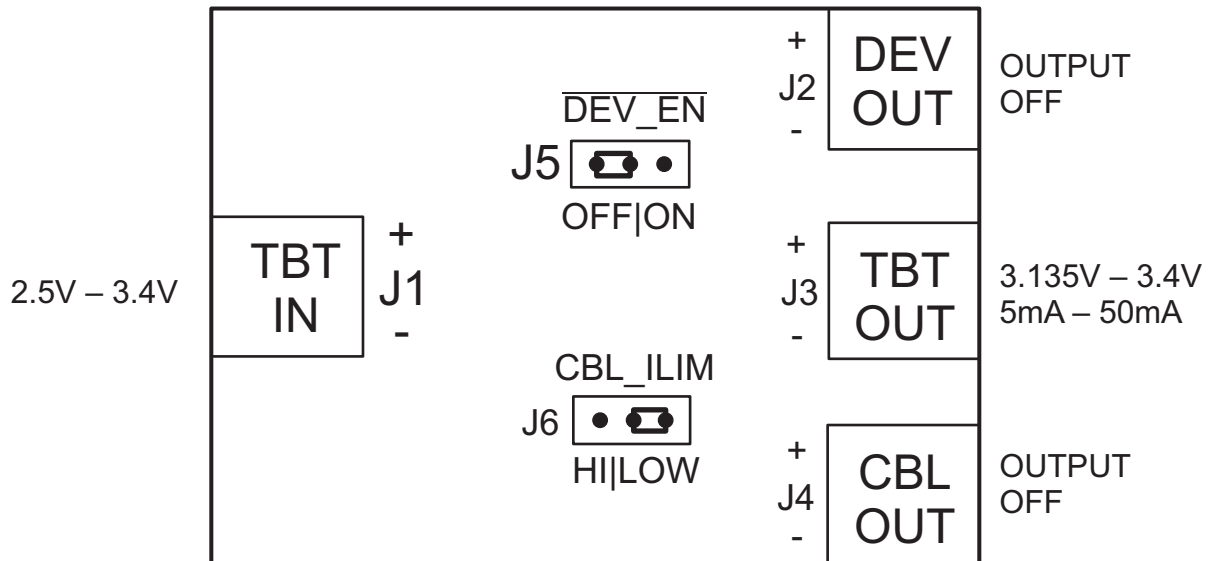
There are two digital input signals which can be set with jumpers as defined in Table 3. These signals can be set to a logical value of “0” or “1” by moving the jumper between the 2 available positions (left and right). See the TPS65980 data sheet for more information on the functionality of these signals.

**Digital Signal Jumpers**

| Header | Name     | Logic | Jumper Position | Effect                             |
|--------|----------|-------|-----------------|------------------------------------|
| J5     | DEV_EN   | 1     | Left (TBT_OUT)  | DEV_OUT Disabled                   |
|        | DEV_EN   | 0     | Right (GND)     | DEV_OUT Enabled                    |
| J6     | CBL_ILIM | 1     | Left (TBT_OUT)  | CBL_OUT using higher current limit |
|        | CBL_ILIM | 0     | Right (GND)     | CBL_OUT using lower current limit  |

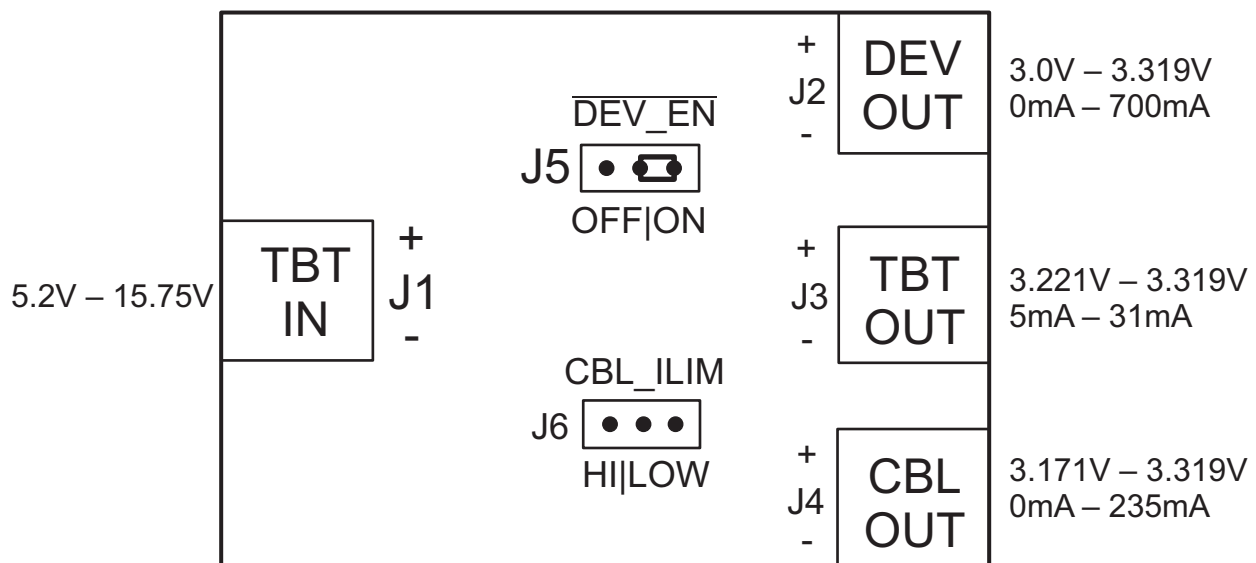
## 2.3 Device Configurations

Figure 2, Figure 3, Figure 4, and Figure 5 illustrate the three operating modes discussed in section 2.1 as well as the two programmable CBL\_OUT current limits.



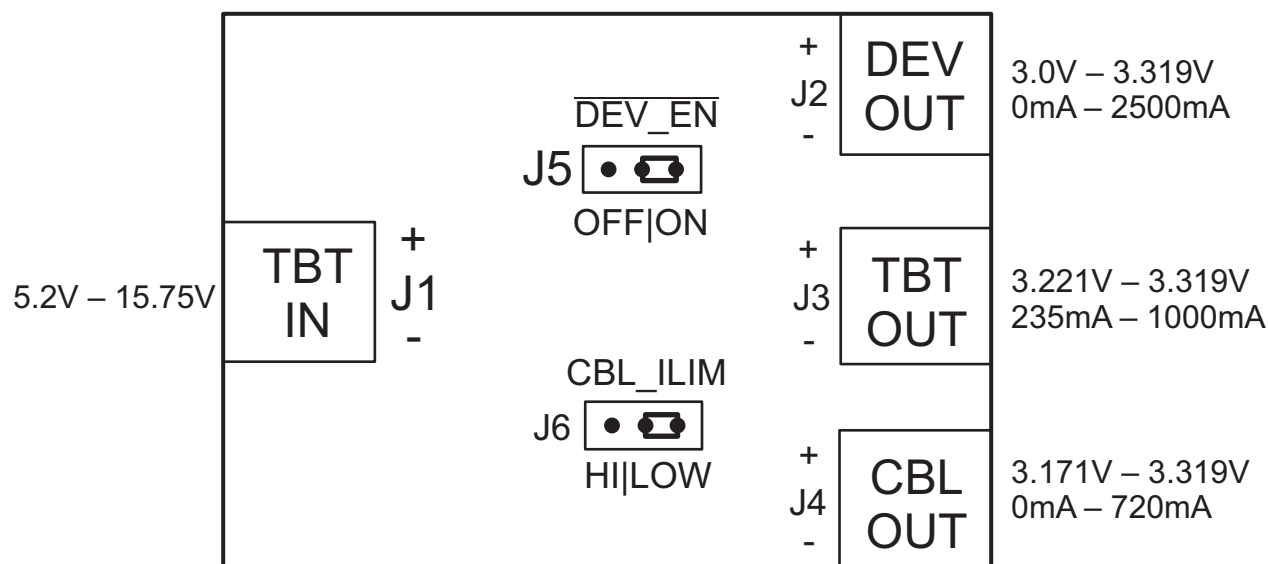
This is the average output voltage range for normal loads. During light load, the peak output voltage from TBT\_OUT may surpass 3.4V, but not exceeding 3.42V

**Figure 2. Low Voltage Input**



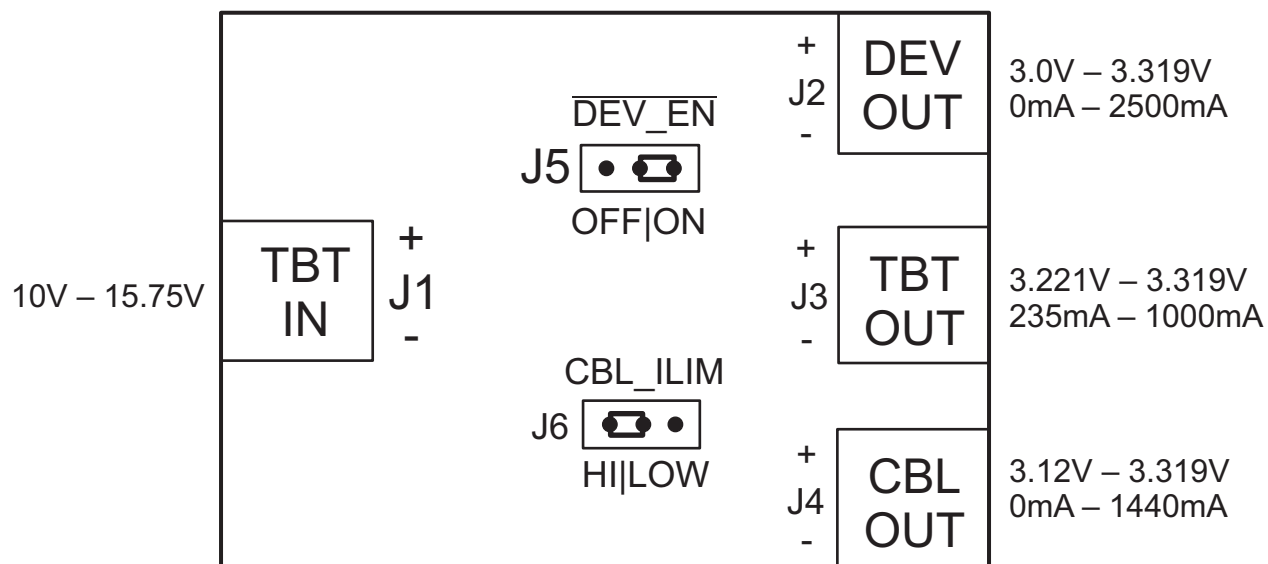
This is the average output voltage range for normal loads. During light load, the average output voltage from CBL\_OUT may reach 3.4 with peaks not exceeding 3.42V.

**Figure 3. High Voltage Input During Sleep**



- A This is the average output voltage range for normal loads. During light load, the average output voltage from TBT\_OUT and CBL\_OUT may reach 3.4 with peaks not exceeding 3.42V
- B The total combined output current from TBT\_OUT, CBL\_OUT, and DEV\_OUT should never exceed 3.5A.

**Figure 4. High Voltage Input With Lower CBL\_OUT Current Limit**



- A This is the average output voltage range for normal loads. During light load, the average output voltage from TBT\_OUT and CBL\_OUT may reach 3.4 with peaks not exceeding 3.42V
- B The total combined output current from TBT\_OUT, CBL\_OUT, and DEV\_OUT should never exceed 3.5A.

**Figure 5. High Voltage Input With Higher CBL\_OUT Current Limit**

## 2.4 Test Points

Several test points are provided solely for the purpose measuring certain signals. It is NOT recommended to use the test points to supply power to TBT\_IN or load TBT\_OUT, CBL\_OUT, or DEV\_OUT.

**Table 2. Test Point Descriptions**

| Test Point | Signal Description |
|------------|--------------------|
| TP1        | GND                |
| TP2        | DEV_OUT            |
| TP3        | Switching Node     |
| TP4        | BOOT               |
| TP5        | GND                |
| TP6        | TBT_IN             |
| TP7        | GND                |
| TP8        | TBT_OUT            |
| TP9        | Compensation Pin   |
| TP10       | GND                |
| TP11       | GND                |
| TP12       | Soft Start Pin     |
| TP13       | RESET_N Signal     |
| TP14       | HV_OK Signal       |
| TP15       | GND                |
| TP16       | CBL_OUT            |

### 3 Board Assembly and Layout

Figure 6 and Figure 7 show the top and bottom assembly for the TPS65980EVM.

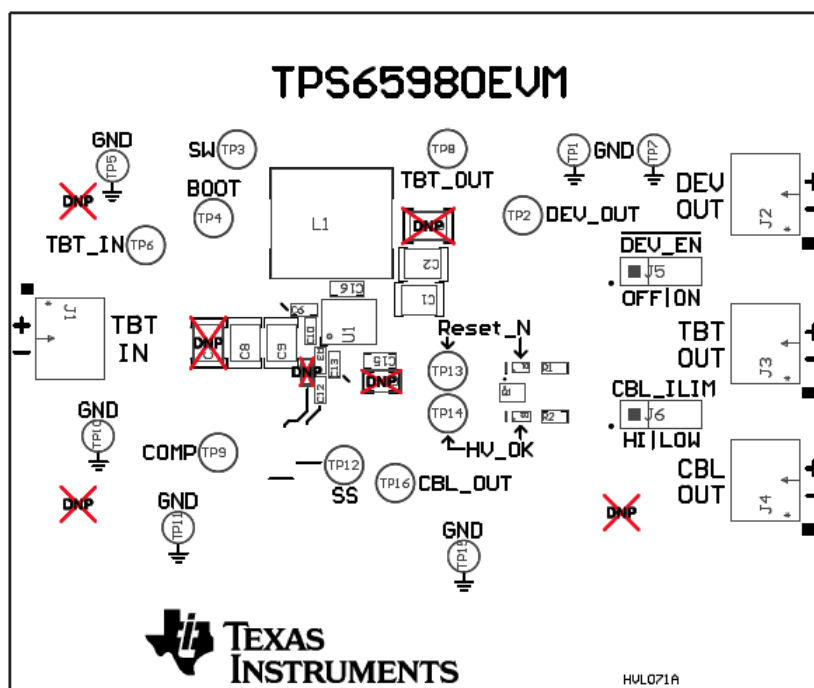


Figure 6. Top Layer Assembly

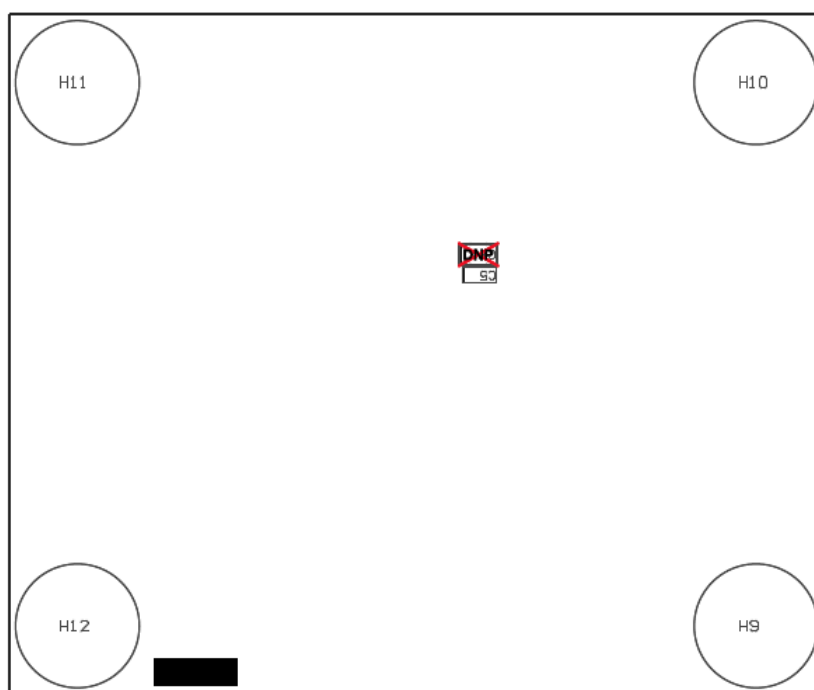


Figure 7. Bottom Layer Assembly

Figure 8 and Figure 9 show the top and bottom layout for the TPS65980EVM.

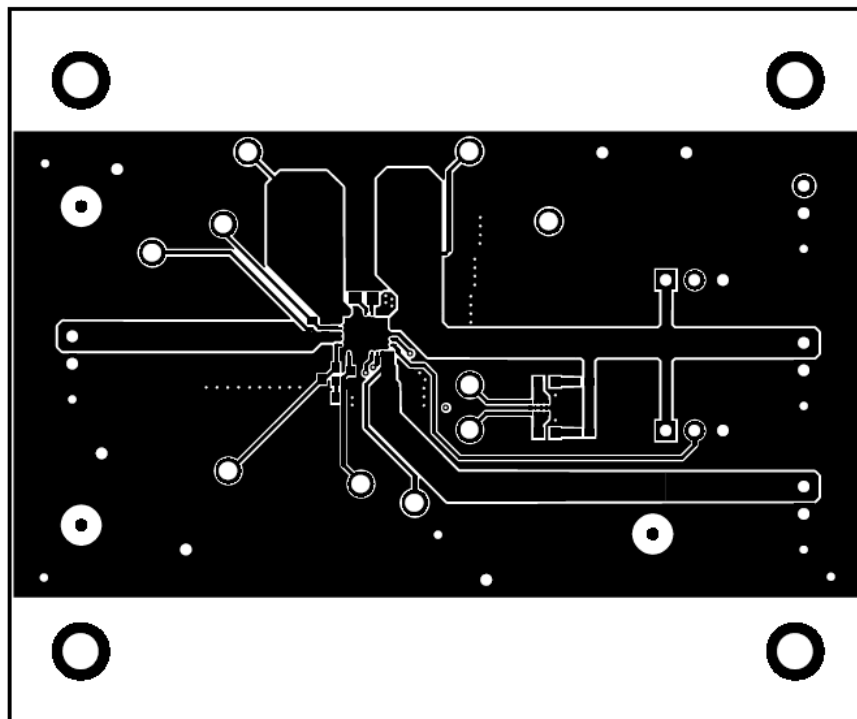


Figure 8. Top Layer Routing

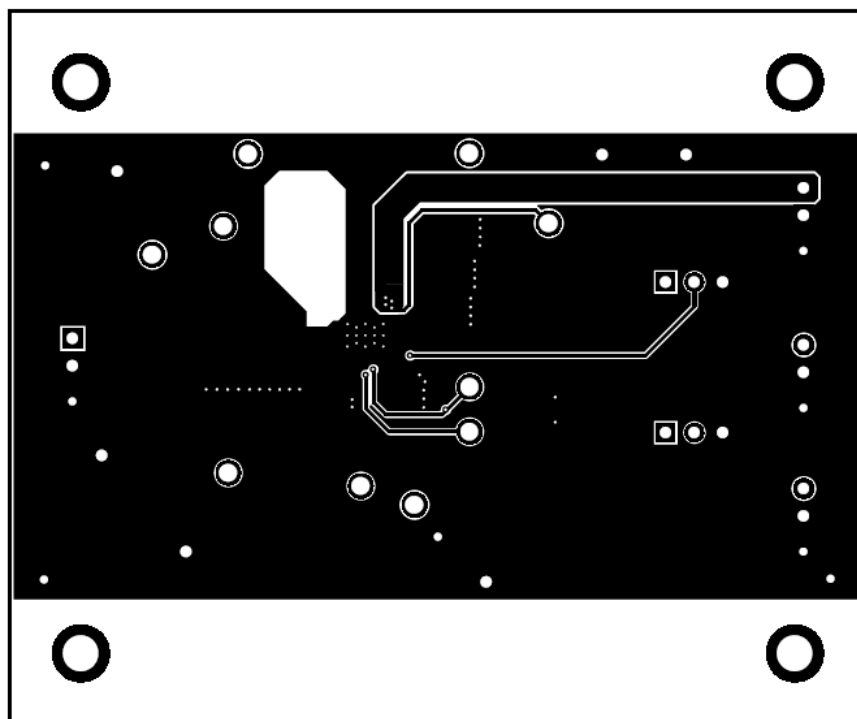


Figure 9. Bottom Layer Routing

## 4 Schematic

The Schematic for the EVM is given in Figure 10.

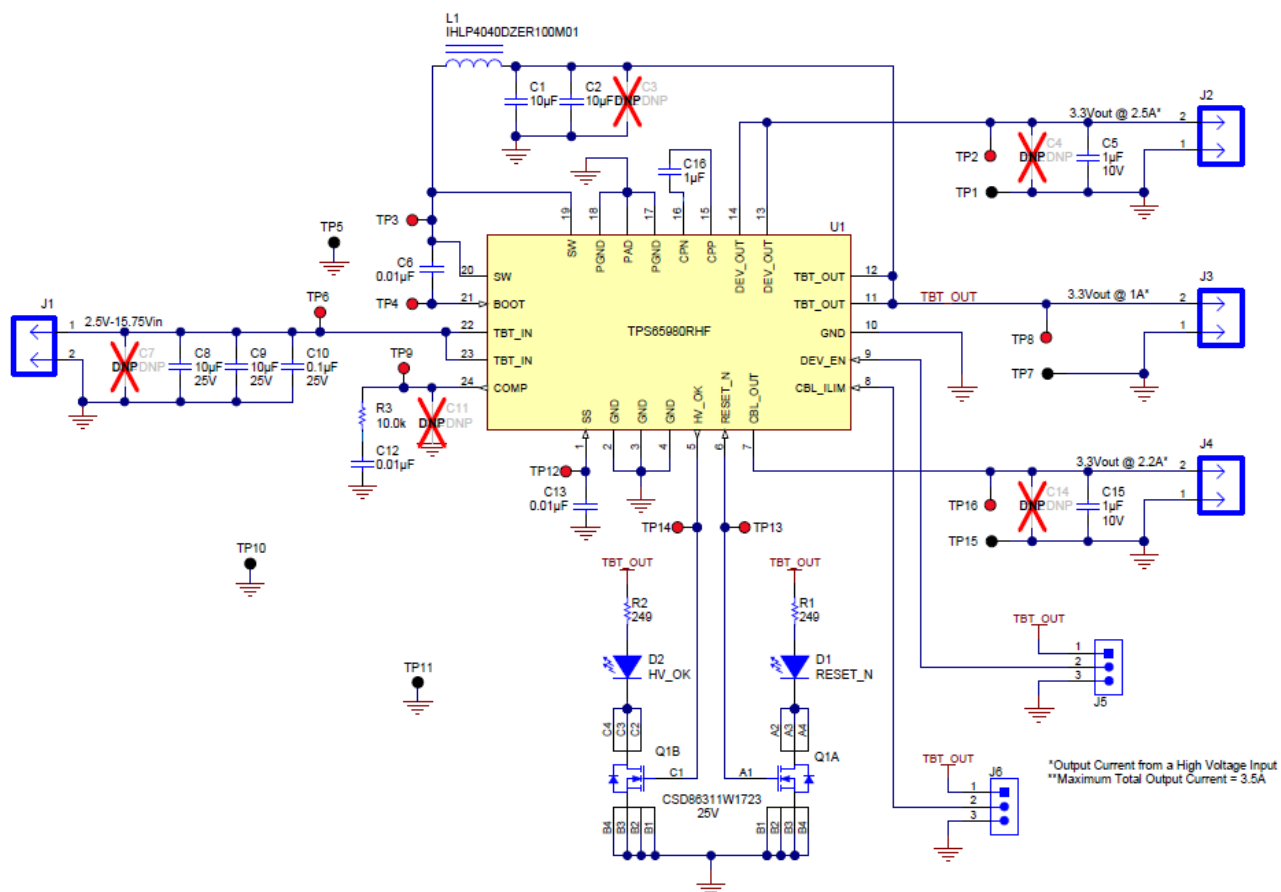


Figure 10. Schematic

## 5 Bill of Materials

This section contains details on the bill of materials for the TPS65980EVM. Unpopulated items have a quantity of 0.

### Bill of Materials

| Designator                                           | Quantity | Value      | Description                                                   | Package Reference         | Part Number         | Manufacturer      | Alternate Part Number | Alternate Manufacturer |
|------------------------------------------------------|----------|------------|---------------------------------------------------------------|---------------------------|---------------------|-------------------|-----------------------|------------------------|
| !PCB                                                 | 1        |            | Printed Circuit Board                                         |                           | HVL071              | Any               |                       |                        |
| C1, C2, C8, C9                                       | 4        | 10μF       | CAP, CERM, 10μF, 25V, ±20%, X7R, 1210                         | 1210                      | C3225X7R1E106M250AC | TDK               |                       |                        |
| C5, C15, C16                                         | 3        | 1μF        | CAP, CERM, 1μF, 10V, ±10%, X5R, 0603                          | 0603                      | GRM188R61A105KA61D  | MuRata            |                       |                        |
| C6, C12, C13                                         | 3        | 0.01μF     | CAP, CERM, 0.01μF, 25V, ±10%, X7R, 0402                       | 0402                      | GRM155R71E103KA01D  | MuRata            |                       |                        |
| C10                                                  | 1        | 0.1μF      | CAP, CERM, 0.1μF, 25V, ±10%, X5R, 0402                        | 0402                      | GRM155R61E104KA87D  | MuRata            |                       |                        |
| D1, D2                                               | 2        | Blue       | LED, Blue, SMD                                                | BLUE 0603 LED             | LB Q39G-L2N2-35-1   | OSRAM             |                       |                        |
| H9, H10, H11, H12                                    | 4        |            | Bumpon, Hemisphere, 0.44 X 0.20, Clear                        | Transparent Bumpon        | SJ-5303 (CLEAR)     | 3M                |                       |                        |
| J1, J2, J3, J4                                       | 4        | C-282834-2 | Header, Shrouded 2-pin, 100 mil space,                        | 6.5x5.54 mm               | C-282834-2          | Tyco              |                       |                        |
| J5, J6                                               | 2        |            | Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator | 3x1 Header                | TSW-103-07-G-S      | Samtec            |                       |                        |
| L1                                                   | 1        | 10μH       | Inductor, Shielded, Powdered Iron, 10μH, 6.8A, 36.5Ω, SMD     | IHLP-4040DZ               | IHLP4040DZER100M01  | Vishay-Dale       |                       |                        |
| Q1                                                   | 1        | 25V        | MOSFET, N-CH, 25V, 4.5A, 2.28x.62x1.7mm                       | 2.28x.62x1.7mm            | CSD86311W1723       | Texas Instruments |                       | None                   |
| R1, R2                                               | 2        | 249        | RES, 249Ω, 1%, 0.063W, 0402                                   | 0402                      | CRCW0402249RFKED    | Vishay-Dale       |                       |                        |
| R3                                                   | 1        | 10.0kΩ     | RES, 10.0kΩ, 1%, 0.063W, 0402                                 | 0402                      | CRCW040210K0FKED    | Vishay-Dale       |                       |                        |
| SH-J5, SH-J6                                         | 2        | 1x2        | Shunt, 100mil, Gold plated, Black                             | Shunt                     | 969102-0000-DA      | 3M                | SNT-100-BK-G          | Samtec                 |
| TP1, TP5, TP7, TP10, TP11, TP15                      | 6        | Black      | Test Point, Miniature, Black, TH                              | Black Miniature Testpoint | 5001                | Keystone          |                       |                        |
| TP2, TP3, TP4, TP6, TP8, TP9, TP12, TP13, TP14, TP16 | 10       | Red        | Test Point, Compact, Red, TH                                  | Red Compact Testpoint     | 5005                | Keystone          |                       |                        |
| U1                                                   | 1        |            | Thunderbolt™ Bus Power Buck/Boost, RHF0024A                   | RHF0024A                  | TPS65980RHF         | Texas Instruments |                       | None                   |
| C3, C7                                               | 0        | 10μF       | CAP, CERM, 10μF, 25V, ±20%, X7R, 1210                         | 1210                      | C3225X7R1E106M250AC | TDK               |                       |                        |
| C4, C14                                              | 0        | 1μF        | CAP, CERM, 1μF, 10V, ±10%, X5R, 0805                          | 0805                      | GRM219R61A105KC01D  | MuRata            |                       |                        |
| C11                                                  | 0        | 0.01μF     | CAP, CERM, 0.01μF, 25V, ±10%, X7R, 0402                       | 0402                      | GRM155R71E103KA01D  | MuRata            |                       |                        |
| FID1, FID2, FID3                                     | 0        |            | Fiducial mark. There is nothing to buy or mount.              | Fiducial                  | N/A                 | N/A               |                       |                        |

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